



Complete Summary

GUIDELINE TITLE

The fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents.

BIBLIOGRAPHIC SOURCE(S)

National High Blood Pressure Education Program Working Group on High Blood Pressure in Children. The fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents. Pediatrics 2004 Aug;114(2 Suppl):555-76. [138 references] [PubMed](#)

GUIDELINE STATUS

This is the current release of the guideline.

COMPLETE SUMMARY CONTENT

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SCOPE

DISEASE/CONDITION(S)

High blood pressure or hypertension

GUIDELINE CATEGORY

Diagnosis
Evaluation
Management
Prevention
Risk Assessment
Treatment

CLINICAL SPECIALTY

Cardiology
Family Practice
Nursing
Nutrition
Pediatrics
Preventive Medicine

INTENDED USERS

Advanced Practice Nurses
Dietitians
Nurses
Patients
Pharmacists
Physician Assistants
Physicians
Public Health Departments

GUIDELINE OBJECTIVE(S)

- To update the 1996 publication from the National High Blood Pressure Education Program (NHPEP) Working Group on Children and Adolescents, "Update on the 1987 Task Force Report on High Blood Pressure in Children and Adolescents."
- To update clinicians on the latest scientific evidence regarding blood pressure in children and to provide recommendations for diagnosis, evaluation, and treatment of hypertension.

TARGET POPULATION

Children and adolescents seen in primary care settings

INTERVENTIONS AND PRACTICES CONSIDERED

Diagnosis

1. Blood pressure (BP) measurement at every health care visit for children greater than 3 years
2. The use of Korotkoff 5 (K5) sounds for diastolic pressure
3. Classification of BP (normal, prehypertension, stage 1 or stage 2 hypertension) based on body size (gender, age, and height)

Evaluation/Risk Assessment

Primary Hypertension and Comorbidities

1. Evaluation for family history of hypertension or cardiovascular disease

2. Risk assessment including medical history, physical examination and laboratory evaluation (low plasma high-density lipoprotein cholesterol, elevated plasma triglyceride and abnormal glucose tolerance tests)
3. History of sleeping pattern (BEARS)

Secondary Hypertension

1. History and physical examination for persistently elevated BP (prior hospitalizations, trauma, urinary tract infections, snoring and other sleep problems, family history of hypertension, diabetes, obesity, sleep apnea, renal disease, other cardiovascular disease [CVD] and familial endocrinopathies, over-the-counter, prescription, and illicit drugs, and nutritional supplements).
2. Body mass index (BMI) calculation
3. Evaluation for target-organ damage (echocardiogram)
4. Retinal exam
5. Ambulatory blood pressure monitoring (ABPM)
6. Renovascular imaging (isotopic scintigraphy, magnetic resonance angiography [MRA], duplex Doppler flow studies, 3-dimensional computed tomography [CT], arteriography [digital-subtraction angiography or classic])

Target-organ Abnormalities

Echocardiogram (left ventricular hypertrophy [LVH])

Management/Treatment/Secondary Prevention

Lifestyle Modification with Family-based Interventions

1. Weight reduction for obesity-related hypertension
2. Physical activity and restriction of sedentary activity
3. Dietary modification

Pharmacologic Therapy

1. Angiotensin converting enzyme (ACE) inhibitors (benazepril, captopril, enalapril, fosinopril, lisinopril, quinapril)
2. Angiotensin-receptor blockers (irbesartan, losartan)
3. Alpha- and beta-blockers (labetalol)
4. Beta-blockers (atenolol, bisoprolol/HCTZ, metoprolol, propranolol)
5. Calcium channel blockers (amlodipine, felodipine, isradipine, extended-release nifedipine)
6. Diuretics
7. Intravenous antihypertensives for hypertensive emergencies

Adjunctive Aspects to Drug Therapy

1. Ongoing BP monitoring
2. Counseling (risk factors and nonpharmacologic measures)
3. Step-down approach
4. Monitoring for target-organ damage

5. Surveillance for drug side effects
6. Monitoring, as indicated, for electrolytes (children treated with ACE inhibitors or diuretics)

MAJOR OUTCOMES CONSIDERED

- Risk and incidence of hypertension among children and adolescents
- Blood pressure readings by gender, age, and height
- Morbidity (e.g., target-organ damage) associated with hypertension
- Efficacy, safety, and tolerability of antihypertensive drug therapy
- Efficacy of nonpharmacologic therapies

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

Overview

The National Heart, Lung, and Blood Institute (NHLBI) director asked several prominent clinicians and scholars to develop background manuscripts on selected issues related to hypertension in children and adolescents. Their manuscripts synthesized the available scientific evidence. During the spring and summer of 2002, NHLBI staff and the chair of the 1996 National High Blood Pressure Education Program (NHBPEP) working group report on hypertension in children and adolescents reviewed the scientific issues addressed in the background manuscripts as well as contemporary policy issues. Subsequently, the staff noted that a critical mass of new information had been identified, thus warranting the appointment of a panel to update the earlier NHBPEP working group report. The NHLBI director appointed the authors of the background papers and other national experts to serve on the new panel.

Search Strategy

The background papers served as focal points for review of the scientific evidence at the first meeting. The members of the working group were assembled into teams, and each team prepared specific sections of the report. In developing the focus of each section, the working group was asked to consider the peer-reviewed scientific literature published in English since 1997.

NUMBER OF SOURCE DOCUMENTS

Not stated

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Weighting According to a Rating Scheme (Scheme Given)

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

The scientific evidence was classified by the system used in the Seventh Report of the Joint National Committee on the Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC7) and is as follows:

M: Indicates meta-analysis (use of statistical methods to combine the results from clinical trials)

RA: Randomized, controlled trials (also known as experimental studies)

RE: Retrospective analyses (also known as case-control studies)

F: Prospective study (also known as cohort studies, including historical or prospective follow-up studies)

X: Cross-sectional survey (also known as prevalence studies)

PR: Previous review or position statements

C: Clinical interventions (nonrandomized)

METHODS USED TO ANALYZE THE EVIDENCE

Review of Published Meta-Analyses
Systematic Review with Evidence Tables

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

Not stated

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus

DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

Members of the working group were assembled into teams, and each team prepared specific sections of the report. The chair of the working group assembled the sections submitted by each team into the first draft of the report. The draft report was distributed to the working group for review and comment. These comments were assembled and used to create the second draft. A subsequent on-site meeting of the working group was conducted to discuss additional revisions and the development of the third-draft document. Amended sections were reviewed, critiqued, and incorporated into the third draft. After editing by the chair for internal consistency, the fourth draft was created. The working group reviewed this draft, and conference calls were conducted to resolve any remaining

issues that were identified. When the working group approved the final document, it was distributed to the Coordinating Committee for review.

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

METHOD OF GUIDELINE VALIDATION

Internal Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

The Coordinating Committee reviewed and approved the final document.

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

Definitions of Hypertension

- Hypertension is defined as average systolic blood pressure (SBP) and/or diastolic blood pressure (DBP) that is ≥ 95 th percentile for gender, age, and height on ≥ 3 occasions.
- Prehypertension in children is defined as average SBP or DBP levels that are ≥ 90 th percentile but < 95 th percentile.
- As with adults, adolescents with blood pressure (BP) levels $\geq 120/80$ mm Hg should be considered prehypertensive.
- A patient with BP levels > 95 th percentile in a physician's office or clinic, who is normotensive outside a clinical setting, has "white-coat hypertension." Ambulatory BP monitoring (ABPM) is usually required to make this diagnosis.

Measurement of Blood Pressure in Children

- Children > 3 years old who are seen in a medical setting should have their BP measured.
- The preferred method of BP measurement is auscultation.
- Correct measurement requires a cuff that is appropriate to the size of the child's upper arm.
- Elevated BP must be confirmed on repeated visits before characterizing a child as having hypertension.
- Measures obtained by oscillometric devices that exceed the 90th percentile should be repeated by auscultation.

Children >3 years old who are seen in medical care settings should have their blood pressure (BP) measured at least once during every health care episode. Children <3 years old should have their BP measured in special circumstances (see Table 1 of the original guideline document).

To confirm hypertension, the BP in children should be measured with a standard clinical sphygmomanometer, using a stethoscope placed over the brachial artery pulse, proximal and medial to the cubital fossa, and below the bottom edge of the cuff (i.e., ~2 cm above the cubital fossa). Ideally, the child whose BP is to be measured should have avoided stimulant drugs or foods, have been sitting quietly for 5 minutes, and seated with his or her back supported, feet on the floor and right arm supported, cubital fossa at heart level.

Correct measurement of BP in children requires use of a cuff that is appropriate to the size of the child's upper right arm. (See Table 2 of the original guideline document for recommended dimensions for BP cuff bladders.)

SBP is determined by the onset of the "tapping" Korotkoff sounds (K1). Population data in children and risk-associated epidemiologic data in adults have established the fifth Korotkoff sound (K5), or the disappearance of Korotkoff sounds, as the definition of DBP. In some children, Korotkoff sounds can be heard to 0 mm Hg. Under these circumstances, the BP measurement should be repeated with less pressure on the head of the stethoscope. Only if the very low K5 persists should K4 (muffling of the sounds) be recorded as the DBP.

Aneroid manometers are quite accurate when calibrated on a semi-annual basis and are recommended when mercury-column devices cannot be obtained.

Auscultation remains the recommended method of BP measurement in children under most circumstances. Use of the automated devices is preferred for BP measurement in newborns and young infants, in whom auscultation is difficult, and in the intensive care setting, in which frequent BP measurement is needed. An elevated BP reading obtained with an oscillometric device should be repeated by using auscultation.

Elevated BP must be confirmed on repeated visits before characterizing a child as having hypertension. Except in the presence of severe hypertension, a more precise characterization of a person's BP level is an average of multiple BP measurements taken over weeks to months.

Ambulatory Blood Pressure Monitoring (ABPM)

Ambulatory blood pressure monitoring (ABPM) requires specific equipment and trained staff; therefore, ABPM in children and adolescents should be used by experts in the field of pediatric hypertension who are experienced in its use and interpretation.

BP Tables

- BP standards based on gender, age, and height provide a precise classification of BP according to body size.

- The revised BP tables now include the 50th, 90th, 95th, and 99th percentiles (with standard deviations) by gender, age, and height.

Refer to the original guideline document for the revised BP tables and instructions on their use.

Hypertension in children has been defined as blood pressure above the 95th percentile for age, sex, and height. Although the 95th percentile provides a BP level that defines hypertension, management decisions about children with hypertension should be determined by the degree or severity of hypertension. (See Table below.)

Classification of Hypertension in Children and Adolescents, With Measurement Frequency and Therapy Recommendations

	SBP or DBP Percentile¹	Frequency of BP Measurement	Therapeutic Lifestyle Changes	Pharmacologic Therapy
Normal	<90th	Recheck at next scheduled physical examination	Encourage healthy diet, sleep, and physical activity	—
Prehypertension	90th to <95th or if BP exceeds 120/80 even if <90th percentile up to <95th percentile ²	Recheck in 6 mo	Weight-management counseling if overweight; introduce physical activity and diet management ³	None unless compelling indications such as chronic kidney disease, diabetes mellitus, heart failure, or LVH exist
Stage 1 hypertension	95th-99th percentile plus 5 mm Hg	Recheck in 1-2 wk or sooner if the patient is symptomatic; if persistently elevated on 2 additional occasions, evaluate or refer to source of care within 1 mo	Weight-management counseling if overweight; introduce physical activity and diet management ³	Initiate therapy based on indications in Table 6 or if compelling indications (as shown above) exist
Stage 2 hypertension	>99th percentile plus 5 mm Hg	Evaluate or refer to source of care within 1 wk or immediately if the patient is symptomatic	Weight-management counseling if overweight; introduce physical activity and diet	Initiate therapy ⁴

	SBP or DBP Percentile¹	Frequency of BP Measurement	Therapeutic Lifestyle Changes	Pharmacologic Therapy
			management ³	

¹For gender, age, and height measured on at least 3 separate occasions; if systolic and diastolic categories are different, categorize by the higher value.

²This occurs typically at 12 years old for SBP and at 16 years old for DBP.

³Parents and children trying to modify the eating plan to the Dietary Approaches to Stop Hypertension Study eating plan could benefit from consultation with a registered or licensed nutritionist to get them started.

⁴More than 1 drug may be required.

Primary Hypertension and Evaluation for Comorbidities

- Primary hypertension is identifiable in children and adolescents.
- Both hypertension and prehypertension have become a significant health issue in the young because of the strong association of high BP with overweight and the marked increase in the prevalence of overweight children.
- The evaluation of hypertensive children should include assessment for additional risk factors.
- Because of an association of sleep apnea with overweight and high BP, a sleep history should be obtained.

Primary hypertension often clusters with other risk factors. Therefore, the medical history, physical examination, and laboratory evaluation of hypertensive children and adolescents should include a comprehensive assessment for additional cardiovascular risk. These risk factors, in addition to high BP and overweight, include low plasma high-density lipoprotein cholesterol, elevated plasma triglyceride, and abnormal glucose tolerance. Fasting plasma insulin concentration is generally elevated, but an elevated insulin concentration may be reflective only of obesity and is not diagnostic of the insulin-resistance syndrome.

To identify other cardiovascular risk factors, a fasting lipid panel and fasting glucose level should be obtained in children who are overweight and have BP between the 90th and 94th percentile and in all children with BP >95th percentile. If there is a strong family history of type 2 diabetes, a hemoglobin A1c or glucose tolerance test may also be considered. These metabolic risk factors should be repeated periodically to detect changes in the level of cardiovascular risk over time.

Approximately 15% of children snore, and at least 1% to 3% have sleep-disordered breathing. Because of the associations with hypertension and the frequency of occurrence of sleep disorders, particularly among overweight children, a history of sleeping patterns should be obtained in a child with hypertension. One practical strategy for identifying children with a sleep problem or sleep disorder is to obtain a brief sleep history, using an instrument called

BEARS (**B**edtime problems, **E**xcessive daytime sleepiness, **A**wakenings during the night, **R**egularity and duration of sleep, and **S**leep-disordered breathing (snoring)).

In a child with primary hypertension, the presence of any comorbidity that is associated with hypertension carries the potential to increase the risk for cardiovascular disease (CVD) and can have an adverse effect on health outcome. Consideration of these associated risk factors and appropriate evaluation in those children in whom the hypertension is verified are important in planning and implementing therapies that reduce the comorbidity risk as well as control BP.

Evaluation for Secondary Hypertension

- Secondary hypertension is more common in children than in adults.
- Because overweight is strongly linked to hypertension, body mass index (BMI) should be calculated as part of the physical examination.
- Once hypertension is confirmed, BP should be measured in both arms and a leg.
- Very young children, children with stage 2 hypertension, and children or adolescents with clinical signs that suggest systemic conditions associated with hypertension should be evaluated more completely than in those with stage 1 hypertension.

Secondary hypertension is more common in children than in adults. The possibility that some underlying disorder may be the cause of the hypertension should be considered in every child or adolescent who has elevated BP. However, the extent of an evaluation for detection of a possible underlying cause should be individualized for each child. Very young children, children with stage 2 hypertension, and children or adolescents with clinical signs that suggest the presence of systemic conditions associated with hypertension should be evaluated more extensively, as compared with those with stage 1 hypertension.

A thorough history and physical examination are the first steps in the evaluation of any child with persistently elevated BP. Elicited information should aim to identify not only signs and symptoms due to high BP but also clinical findings that might uncover an underlying systemic disorder. Thus, it is important to seek signs and symptoms suggesting renal disease (gross hematuria, edema, fatigue), heart disease (chest pain, exertional dyspnea, palpitations), and diseases of other organ systems (e.g., endocrinologic, rheumatologic).

Past medical history should elicit information to focus the subsequent evaluation and to uncover definable causes of hypertension. Questions should be asked about prior hospitalizations, trauma, urinary tract infections, snoring and other sleep problems. Questions should address family history of hypertension, diabetes, obesity, sleep apnea, renal disease, other cardiovascular disease (CVD) (hyperlipidemia, stroke), and familial endocrinopathies. Many drugs can increase BP, so it is important to inquire directly about use of over-the-counter, prescription, and illicit drugs. Equally important are specific questions aimed at identifying the use of nutritional supplements, especially preparations aimed at enhancing athletic performance.

Physical Examination

The child's height, weight, and percentiles for age should be determined at the start of the physical examination. Because obesity is strongly linked to hypertension, body mass index (BMI) should be calculated from the height and weight, and the BMI percentile should be calculated. Poor growth may indicate an underlying chronic illness. When hypertension is confirmed, BP should be measured in both arms and in a leg. The remainder of the physical examination should pursue clues found on history and should focus on findings that may indicate the cause and severity of hypertension. (See Table 8 of the original guideline document for a list of important physical examination findings in hypertensive children.)

The risk factors, or comorbid conditions, associated with primary hypertension should be included in the evaluation of hypertension in all children, as well as efforts to determine any evidence of target-organ damage.

Additional Diagnostic Studies for Hypertension

Additional diagnostic studies may be appropriate in the evaluation of hypertension in a child or adolescent, particularly if there is a high degree of suspicion that an underlying disorder is present. Such procedures are listed in Table 7 of the original guideline document. ABPM, discussed previously, has application in evaluating both primary and secondary hypertension. ABPM is also used to detect white-coat hypertension.

Renin Profiling

Plasma renin level or plasma rennin activity (PRA) is a useful screening test for mineralocorticoid-related diseases.

Evaluation for Possible Renovascular Hypertension

Renovascular hypertension is a consequence of an arterial lesion or lesions impeding blood flow to 1 or both kidneys or to ≥ 1 intrarenal segments. Affected children usually, but not invariably, have markedly elevated BP. Evaluation for renovascular disease also should be considered in infants or children with other known predisposing factors such as prior umbilical artery catheter placements or neurofibromatosis. The recommended approaches generally use older techniques such as standard intraarterial angiography, digital-subtraction angiography (DSA), and scintigraphy (with or without angiotensin-converting enzyme [ACE] inhibition). As technologies evolve, children should be referred for imaging studies to centers that have expertise in the radiologic evaluation of childhood hypertension.

Invasive Studies

Digital-subtraction angiography (DSA) and formal arteriography are still considered the "gold standard," but these studies should be undertaken only when surgical or invasive interventional radiologic techniques are being contemplated for anatomic correction. Refer to the original guideline document for discussion on other imaging techniques.

Target-Organ Abnormalities in Childhood Hypertension

- Target-organ abnormalities are commonly associated with hypertension in children and adolescents.
- Left ventricular hypertrophy (LVH) is the most prominent evidence of target-organ damage.
- Pediatric patients with established hypertension should have echocardiographic assessment of left ventricular mass at diagnosis and periodically thereafter.
- The presence of left ventricular hypertrophy (LVH) is an indication to initiate or intensify antihypertensive therapy.

Echocardiography is recommended as a primary tool for evaluating patients for target-organ abnormalities by assessing the presence or absence of LVH.

Children and adolescents with established hypertension should have an echocardiogram to determine if LVH is present. A conservative cutpoint that determines the presence of LVH is $51 \text{ g/m}^{2.7}$. This cutpoint is >99th percentile for children and adolescents and is associated with increased morbidity in adults with hypertension.

Ascertainment of left ventricular mass index is very helpful in clinical decision-making. The presence of LVH can be an indication for initiating or intensifying pharmacologic therapy to lower BP. For patients who have LVH, the echocardiographic determination of left ventricular mass index should be repeated periodically.

At the present time, additional testing for other target-organ abnormalities (such as determination of carotid intimal-medial thickness and evaluation of urine for microalbuminuria) is not recommended for routine clinical use.

Therapeutic Lifestyle Changes

- Weight reduction is the primary therapy for obesity-related hypertension. Prevention of excess or abnormal weight gain will limit future increases in BP.
- Regular physical activity and restriction of sedentary activity will improve efforts at weight management and may prevent an excess increase in BP over time.
- Dietary modification should be strongly encouraged in children and adolescents who have BP levels in the prehypertensive range as well as those with hypertension.
- Family-based intervention improves success.

On the basis of large, randomized, controlled trials, the following lifestyle modifications are recommended in adults: weight reduction in overweight or obese individuals; increased intake of fresh vegetables, fruits, and low-fat dairy (the Dietary Approaches to Stop Hypertension Study eating plan); dietary sodium reduction; increased physical activity; and moderation of alcohol consumption. Smoking cessation has significant cardiovascular benefits. As information on chronic sleep problems evolves, interventions to improve sleep quality also may have a beneficial effect on BP.

Emphasis on the management of complications rather than on overweight shifts the aim of weight management from an aesthetic to a health goal. In motivated families, education or simple behavior modification can be successful in achieving moderate weight loss or preventing additional weight gain. Steps can be implemented in the primary care setting even with limited staff and time resources. The patient should be encouraged to self-monitor time spent in sedentary activities, including watching television and playing video or computer games, and set goals to progressively decrease these activities to <2 hours per day. The family and patient should identify physical activities that the child enjoys, engage in them regularly, and self-monitor time spent in physical activities (30–60 minutes per day should be achieved). Dietary changes can involve portion-size control, decrease in consumption of sugar-containing beverages and energy-dense snacks, increase in consumption of fresh fruits and vegetables, and regular meals including a healthy breakfast. Consultation with a nutritionist can be useful and provide customized recommendations. During regular office visits, the primary care provider can supervise the child's progress in self-monitoring and accomplishing goals and provide support and positive feedback to the family. Some patients will benefit from a more intense and comprehensive approach to weight management from a multidisciplinary and specialized team if available.

Regular aerobic physical activity (30–60 minutes of moderate physical activity on most days) and limitation of sedentary activities to <2 hours per day are recommended for the prevention of obesity, hypertension, and other cardiovascular risk factors. With the exception of power lifting, resistance training is also helpful. Competitive sports participation should be limited only in the presence of uncontrolled stage 2 hypertension. Refer to the original guideline document for further discussion of therapeutic lifestyle changes.

Pharmacologic Therapy

- Indications for antihypertensive drug therapy in children include secondary hypertension and insufficient response to lifestyle modifications.
- Dosing recommendations for many of the newer drugs are provided in the original guideline document.
- Pharmacologic therapy, when indicated, should be initiated with a single drug. Acceptable drug classes for use in children include ACE inhibitors, angiotensin-receptor blockers, beta-blockers, calcium channel blockers, and diuretics.
- The goal for antihypertensive treatment in children should be reduction of BP to <95th percentile unless concurrent conditions are present, in which case BP should be lowered to <90th percentile.
- Severe symptomatic hypertension should be treated with intravenous antihypertensive drugs.

A definite indication for initiating pharmacologic therapy should be ascertained before a drug is prescribed. Table 6 in the original guideline document summarizes the indications for use of antihypertensive drugs in children. Indications include symptomatic hypertension, secondary hypertension, established hypertensive target-organ damage, and failure of nonpharmacologic measures. Other indications for use of antihypertensive drugs can be considered depending on the clinical situation.

Table 9 in the original guideline document contains dosing recommendations for antihypertensive drugs in children 1–17 years old.

Because all classes of antihypertensive drugs have been shown to lower BP in children, the choice of drug for initial antihypertensive therapy resides in the preference of the responsible physician. Some diuretics and beta-adrenergic blockers, which were recommended as initial therapy in the first and second task force reports, have a long history of safety and efficacy based on clinical experience in hypertensive children, and these drugs remain appropriate for pediatric use. Similarly, some members of the newer classes of antihypertensive drugs, including ACE inhibitors, calcium channel blockers, and angiotensin-receptor blockers, have been studied in children and, based on short-term use, shown to be safe and well-tolerated with satisfactory BP reductions in hypertensive children.

Specific classes of antihypertensive drugs should be used preferentially in certain hypertensive children with specific underlying or concurrent medical conditions. Examples include the use of ACE inhibitors or angiotensin-receptor blockers in children with diabetes and microalbuminuria or proteinuric renal diseases, and the use of beta-adrenergic blockers or calcium channel blockers in hypertensive children with migraine headaches.

All antihypertensive drugs should be prescribed in a similar fashion: The child is initially started on the lowest recommended dose. (See Table 9 of the original guideline document.) The dose can be increased until the desired BP goal is achieved. Once the highest recommended dose is reached, or if the child experiences side effects from the drug, a second drug from a different class should be added. Consideration should be given to combining drugs with complementary mechanisms of action such as an ACE inhibitor with a diuretic or a vasodilator with a diuretic or beta-adrenergic blocker. Because little pediatric experience is available in using fixed-dose combination products, except for bisoprolol/hydrochlorothiazide, routine use of these products in children cannot be recommended at this time.

For children with uncomplicated primary hypertension and no hypertension target-organ damage, the goal BP should be <95th percentile for gender, age, and height, whereas for children with chronic renal disease, diabetes, or hypertensive target-organ damage, the goal BP should be <90th percentile for gender, age, and height.

Important adjunctive aspects to the drug therapy of childhood hypertension include ongoing monitoring of target-organ damage as well as BP monitoring, surveillance for drug side effects, periodic monitoring of electrolytes in children treated with ACE inhibitors or diuretics, counseling regarding other cardiovascular risk factors, and continued emphasis on nonpharmacologic measures. It also may be appropriate to consider "step-down" therapy in selected patients. Children with uncomplicated primary hypertension, especially overweight children who successfully lose weight, are the best candidates for the step-down approach. Such patients require ongoing BP monitoring after the cessation of drug therapy as well as continued nonpharmacologic treatment, because hypertension may recur.

Severe, symptomatic hypertension with BP well above the 99th percentile occurs in some children, usually those with underlying renal disease, and requires prompt treatment. Hypertensive emergencies in children are usually accompanied by signs of hypertensive encephalopathy, typically causing seizures. Hypertensive emergencies should be treated by an intravenous antihypertensive that can produce a controlled reduction in BP, aiming to decrease the pressure by $\leq 25\%$ over the first 8 hours after presentation and then gradually normalizing the BP over 26 to 48 hours. Hypertensive urgencies are accompanied by less serious symptoms such as severe headache or vomiting. Hypertensive urgencies can be treated by either intravenous or oral antihypertensives depending on the child's symptomatology (See Table 10 in the original guideline document for dosing recommendations for treatment of severe hypertension in children when prompt reduction of BP is indicated.)

Figure 1 in the original guideline document is a management algorithm that presents guidelines for evaluation and treatment of stage 1 and stage 2 hypertension in children and adolescents. The algorithm summarizes monitoring and intervention recommendations for children and adolescents with prehypertension and hypertension. Included in the algorithm are points at which the presence of overweight is considered in clinical decision-making. The algorithm also emphasizes the inclusion of evaluation for target-organ damage in children with established stage 1 and stage 2 hypertension.

CLINICAL ALGORITHM(S)

An algorithm is provided in the original guideline document for the management of hypertension.

EVIDENCE SUPPORTING THE RECOMMENDATIONS

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The type of supporting evidence is not specifically stated for each recommendation.

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

On the basis of developing evidence, it is now apparent that primary hypertension is detectable in the young and occurs commonly. The long-term health risks for hypertensive children and adolescents can be substantial; therefore, it is important that clinical measures be taken to reduce these risks and optimize health outcomes.

POTENTIAL HARMS

Medications used to treat hypertension may result in side effects. Refer to Table 9 in the original guideline document for comments on potential side effects of individual medication.

CONTRAINDICATIONS

CONTRAINDICATIONS

Contraindications and cautions to specific antihypertensive medications are listed in the comment section of Table 9 in the original guideline document.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

IMPLEMENTATION TOOLS

Clinical Algorithm

For information about [availability](#), see the "Availability of Companion Documents" and "Patient Resources" fields below.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Getting Better
Living with Illness
Staying Healthy

IOM DOMAIN

Effectiveness
Patient-centeredness

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

National High Blood Pressure Education Program Working Group on High Blood Pressure in Children. The fourth report on the diagnosis, evaluation, and treatment of high blood pressure in children and adolescents. Pediatrics 2004 Aug;114(2 Suppl):555-76. [138 references] [PubMed](#)

ADAPTATION

Not applicable: The guideline was not adapted from another source.

DATE RELEASED

2004 Aug

GUIDELINE DEVELOPER(S)

National Heart, Lung, and Blood Institute (U.S.) - Federal Government Agency
[U.S.]

SOURCE(S) OF FUNDING

National Heart, Lung, and Blood Institute (NHLBI)

GUIDELINE COMMITTEE

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FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Joseph T. Flynn, MD, MS is a paid contributor to Pfizer, Inc, Novartis Pharmaceuticals, AstraZeneca, Inc, and ESP-Pharma.

GUIDELINE STATUS

This is the current release of the guideline.

GUIDELINE AVAILABILITY

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AVAILABILITY OF COMPANION DOCUMENTS

None available

PATIENT RESOURCES

None available

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